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FLOODING IN NOVA SCOTIA AN OVERVIEW: 1759-1986

Summary

In his 1873 account of the first settlers of Colchester County, Nova Scotia, Thomas Miller wrote:

> *"The first settlers of Stewiacke had many difficulties to contend against. On September 8, 1792, there was the great freshet which carried away a large part of their wheat which was standing in stook in the field. Many of their houses stood on the interval, and were in danger of being carried away. Many made rafts of boards from the floors of their homes and pushed off for higher land, while those who had canoes were busy saving the people first and afterwards the cattle and sheep. After this they very prudently built more of their houses on the uplands".*[1]

Many people seem to have forgotten or ignored that lesson, particularly in this century. The marked increase in reported floods and flood-related damages in this century is linked to the increased settlement and development attracted to floodplains by the existence of major land-based transportation arteries and the ease to which municipal infrastructure could be constructed. In a few cases, the floodplain represented the major portion of the land bank of the community. This report is a summary of available information regarding the causes, magnitude and other identifiable characteristics associated with these floods.

This information indicates that flooding has been a costly problem in the Province. At least six floods have caused over $5 million (1986 $s) in damages. During major flood events, both the public and private sectors of the economy are significantly affected.

In addition, floods cause other types of damage which cannot be evaluated in monetary terms. Floods have been directly or indirectly responsible for at least 30 deaths since 1759. The anguish associated with evacuations forced by rising flood waters, the inconvenience of business closures and lengthy detours are often intangible damages caused by flooding.

The primary causes of flooding in Nova Scotia are rainfall, snowmelt, ice jams and surging tides. The majority of floods involved a combination of these factors. Although floods have occurred during every month of the year, the majority of such events take place from December to April, when the potential is greatest for a convergence of the primary causes of flooding.

There is evidence that certain areas of the Province, such as the Salmon and North River Basins, particularly near Truro, are more affected by floods than other regions. However, flood damages have been reported in every region of Nova Scotia.

Flooding has been and continues to be a serious problem in this Province. This report is intended to contribute to a greater understanding of the nature and extent of flooding in Nova Scotia, and thereby help reduce the risk it represents.

1. HISTORICAL AND GENEOLOGICAL RECORD OF THE FIRST SETTLERS OF COLCHESTER COUNTY, DOWN TO THE PRESENT TIME, THOMAS MILLER, 1873. A. & W. MACKINLAY PUBLISHING, HALIFAX, NOVA SCOTIA.

Foreword

Since 1978, Environment Canada and the Nova Scotia Department of the Environment have been collaborating, under the auspices of the Canada-Nova Scotia Flood Damage Reduction Program, to reduce the negative impact of flooding in the Province. Under the program, a number of selected flood risk areas have been mapped for the information of community planners, as well as potential builders and developers, since the most effective long term remedy to reduce flood damages is to avoid building on flood-prone lands, or at least take measures to protect future development in flood-vulnerable areas. The program has also supported studies to identify cost-effective and environmentally sound flood damage reduction measures for existing development.

To aid in the development and implementation of the program, and to contribute to a general understanding of the nature and extent of flooding in Nova Scotia, Environment Canada, with the assistance and cooperation of the Nova Scotia Department of the Environment, has prepared a consolidated source of background information on flooding in the Province. *"Flooding Events in Nova Scotia – An Historical Perspective"* includes detailed individual descriptions of the 156 recorded flooding events which have occurred in the Province since 1759.

89-04556/

This substantial and significant mass of flood-related information was obtained through extensive research of newspaper accounts, files of government agencies, and various government and privately produced publications.

"*Flooding in Nova Scotia — An Historical Perspective*" is a lengthy and comprehensive report. This overview provides a brief look at the many aspects of flooding that was thoroughly covered in the original document. Readers desiring a fuller discussion or additional statistics with regard to an individual aspect of flooding or a particular flood should refer to the original report, copies of which are available through Environment Canada at the mailing address provided at the end of this document.

Environment Canada intends to periodically update this report as and when new information becomes available. Accordingly, it would be greatly appreciated if those readers of this document who know of additional and/or more accurate flood-related information would make such information known to us, thus contributing to a thorough and up-to-date body of knowledge on the subject of flooding in Nova Scotia.

Is Flooding a Recent Phenomenon in Nova Scotia?

On the third and fourth of November, 1759, a storm accompanied by surging tides resulted in Nova Scotia's first recorded flood, which over-topped dykes and flooded land all along the Bay of Fundy and also destroyed wharves and provisions in the growing community of Halifax. Since then, 155 floods have been recorded in the Province, and only a few decades have passed by without some flooding activity. An illustration of documented flood events (Figure 1) indicates there has been a rather dramatic increase in reported flood events since the early part of this century.

Photograph 1 *— Flooded Section of Old #3 Highway at Hubbards, circa 1930's.*

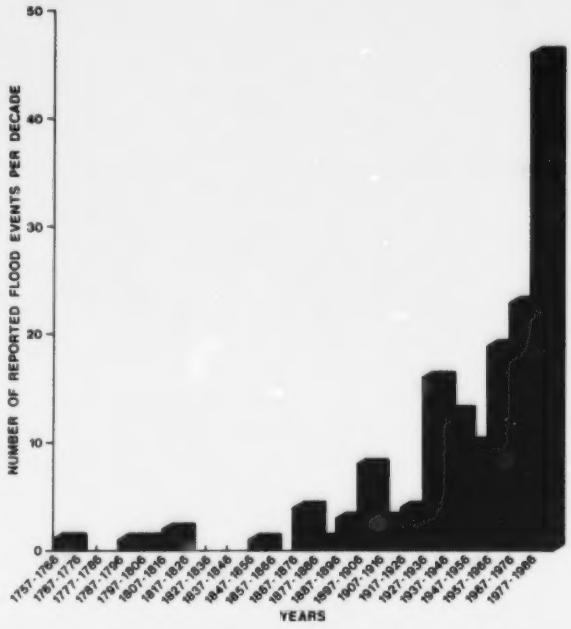


Figure 1: *Number of Reported Flood Events Per Decade from 1757-1986.*

The reason for this increase cannot be identified with certainty, and some likely explanations do not bear up under scrutiny. Have water levels in provincial lakes and rivers been rising in the last century? Available water level statistics regarding the Province's inland waters indicate no such trend. There has been a gradual increase in tidal water levels relative to the land surface in some coastal areas; however, tides were a significant factor in only a small percentage of the Province's floods. Could increased media awareness of the problems have resulted in more floods being reported? The study of accounts carried out for this report strongly suggests that floods affecting a substantial number of people were as likely to receive coverage in the eighteenth century as the twentieth, though perhaps in less detail.

However, there is likely a connection between an increased population density and a rise in reported flood events. As population expands and communities begin to grow, the fertile soils and access to water-based transportation offered by floodplains make them attractive areas for settlement. The result was that more and more people were becoming vulnerable to the effects of flooding. Increasing numbers of Nova Scotians were discovering that, while land on or near floodplains offered advantages in regard to agriculture, transportation and scenery, flooding was a troubling and costly disadvantage.

It is also probable that three additional factors, related in part to the above, have compounded the problem in recent years: (i) very high risk floodplain lands are

typically, but not always, developed after the supply of low risk land has been exhausted, thus contributing to the trend towards increasing flood impacts; (ii) modern building styles, for example finished living areas in basements as opposed to root cellars in the past, have resulted in an increase in potential damages; and (iii) older construction was occasionally flood-proofed by building on natural or artificial mounds. This feature is often, but not always, absent in newer construction.

In addition, it is likely that the establishment of locations to collect rainfall and streamflow statistics in the early part of this century has contributed to an increase in flood reports, as data from these locations in part identified past dates on which flooding events likely occurred, enabling more focussed research.

What are the Major Causes of Flooding in the Province?

Precipitation from cyclonic (including hurricanes) and convective storms, along with ice jams, snowmelt, and tidewaters are the major causes of flooding in Nova Scotia. As can be seen in Figure 2, a large proportion of flood events involve a combination of some or all of the above factors.

Convective Storms

Convective storms often resulted in heavy rainfall and were the single most common cause of flooding in Nova Scotia. Usually, however, floods caused by this source are not very destructive. The flood of August 25-26, 1958, a typical convective event, caused minor damages to homes and businesses in Digby when the storm sewers could not handle the runoff from the three hours of torrential rain. Convective storms are seldom the cause of significant area-wide flood events. However, when the rainfall activity extends over a longer period of time, as occurred in the event of April 28-29, 1982, serious flooding can occur. In that instance, locations as far apart as Truro and Baddeck were affected.

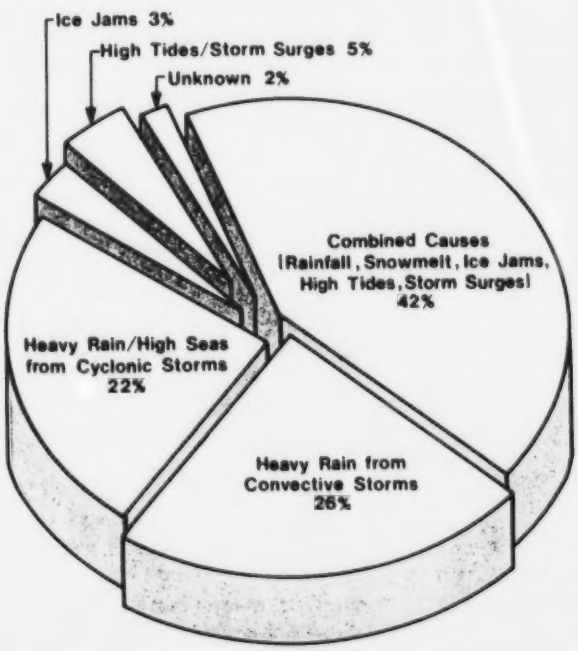

Ice Jams 3%
High Tides/Storm Surges 5%
Unknown 2%
Combined Causes (Rainfall, Snowmelt, Ice Jams, High Tides, Storm Surges) 42%
Heavy Rain/High Seas from Cyclonic Storms 22%
Heavy Rain from Convective Storms 26%

Figure 2: *Causes of Flooding in Nova Scotia.*

Hurricanes and Cyclonic Storms

Although tropical or hurricane-type storms have usually lost their full force by the time they reach Nova Scotia, Hurricane Ethel in 1964, Hurricane Gladys in 1968, and Hurricane Beth in 1971, all caused significant flooding in the Province. Unidentified hurricane-like storms struck the Province in September, 1936 and August, 1950, as well.

Extra-tropical or cyclonic storms often result in heavy rainfall and high seas over a large area for lengthy periods of time and can, by themselves, result in serious flood conditions. Such was the case in the flood of October 10-11, 1967, which resulted in extensive flood damages. Cyclonic storms may also increase the rate of snowmelt and contribute to the formation of ice jams during floods.

Both hurricane and cyclonic storms are usually accompanied by tidal surges which have often caused significant damages to wharves, fishing boats and fishing gear, as well as other on-shore installations. This occurred during the floods of September 16-18, 1940; June 2-3, 1948; August 18-20, 1949; and the "Groundhog Day Storm" of February 2-3, 1976.

Snowmelt

Although snowmelt, by itself, caused no flooding events, it was a contributing factor in 65 instances.

Flooding conditions associated with snowmelt often occur during winter rain storms in December, January and February. Spells of warm weather accompanied by rain are not that unusual in Nova Scotia during these months. In fact, such conditions led to all 48 flood events recorded in Nova Scotia during these three months, 36 of which involved snowmelt. Prolonged warm spells during these months can be particularly disastrous. For instance, in what was called the longest "January thaw" in Nova Scotia history, from January 3-18, 1956, the resulting flood conditions caused extensive province-wide damages.

Floods involving snowmelt also occur when a heavy rainfall accompanies the annual spring runoff. This was the case in most of the 35 floods recorded in March and April. The worst floods of this type occur following a winter of heavy snowfall. The event of April 2-10, 1962, which affected almost the entire Province, was caused by heavy rain during the spring snowmelt period. Also, during this event, the ice cover broke up and jammed, worsening the situation.

Ice Jams

Severe flood conditions associated with ice jamming generally occur during winter thaws and spring break-up periods. Jams are caused by restrictions in the movement of ice. Most often, these restrictions are caused by the narrowing of a river channel, or by islands, shoals or man-made structures crossing the waterway. Floods involving ice jams tend to be more destructive than open water events, particularly to bridge structures. For example, during the flood of early January, 1956, which featured a series of ice jams across the Province, over 100 bridges were destroyed.

While ice jams, by themselves, caused only five floods, they contributed, often quite destructively, to another 49 flood events.

***Photograph 2** — Ice Jam flood, Salmon River near Truro, February 1972.*

Tides

Unusually high tides caused floods in April, 1958; November, 1976; June, 1977; and during the winter of 1984. However, the most serious coastal flooding in Nova Scotia has resulted from storm surges which accompany hurricanes and cyclonic storms. This was the case during the flood of October 25-28, 1959, when coastal locations such as Parrsboro sustained extensive flood damages, including road washouts, flooded homes, and submerged streets.

Tidal flooding is likely to worsen in the future. The combination of sea level rise and land settling, while a slow and gradual process, will increase flood risk in many coastal communities. Furthermore, recent studies have suggested the rate of sea level rise will accelerate as the result of climate change.

Is There An Increased Risk of Flooding at Certain Times of the Year?

Floods have occurred during every month of the year in Nova Scotia. However, as Figure 3 indicates, very few have taken place during May, June and July.

The most destructive events occur from December to April, when the potential exists for a convergence of the three major causes of floods — rainfall, snowmelt and ice jams. Out of a total of 156 events, 83 major and minor floods, or 53%, have taken place during these five months.

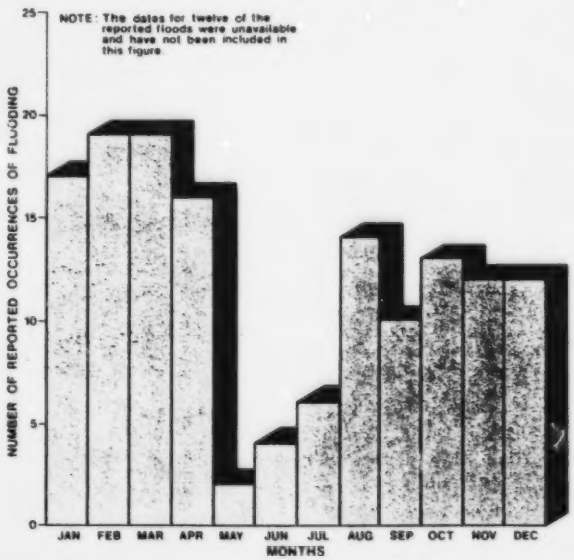


***Figure 3:** Distribution of Reported Flood Events in Nova Scotia by Month.*

However, major floods are not unheard of in the summer or fall. Floods causing millions of dollars in damage took place in August, 1971 and October, 1959. Major floods occurring from June to November are usually the result of hurricanes or severe cyclonic storms, as was the case in both of the above instances (August, 1971 — Hurricane Beth; October, 1959 — cyclonic storm).

What Areas of the Province were Affected By the Major Recorded Flood Events?

Any flood is no doubt considered major by those people whose homes, land, businesses or transportation systems are inundated. However, if a major flood is defined in terms of large scale destructiveness, the six floods which each caused in excess of $5 million (1986 $s) in estimated damages would have to be considered major flood events. As indicated in Table 1, the impact of these floods was felt throughout the Province.

The Salmon/North River Basins, which include Truro and its environs, sustained damages in all but one of these major events, and in many less destructive floods as well. The Kentville area in the Cornwallis River Valley, the New Glasgow-Stellarton region of the East River of Pictou, and the towns of Bridgetown, Lawrencetown, Paradise and Middleton along the Annapolis River were also frequent victims of flood damages. Other areas noteworthy in this regard include Bridgewater on the LaHave River, the Antigonish area (Brierly Brook, South, West and Rights Rivers), and the Bedford-Sackville area (the Sackville and Little Sackville Rivers).

Generally, what these and other affected areas in Figure 4 have in common are concentrations of population situated on or near low lying lands. This combination of location and population makes these areas particularly vulnerable to damages during major flood events.

Table 1 — River Basins Affected During Selected Major Flood Events (All estimated damages are reported in millions of '986 $s)

River Basin	Flood of				
	Jan. 1935 $14.9	Aug. 1950 $6.6	Jan. 1956 $27.8	Feb. 1971 $5.2	Aug. 1971 $13.4
Salmon/North	X	X	X	X	X
Cornwallis	X	X	X	X	X
East, West Middle Rivers of Pictou	X	X	X	X	X
Annapolis	X	X	X	X	X
LaHave	X	X	X	X	X
South, West, Rights Rivers Brierly Brook	X		X	X	X
Shubenacadie/ Stewiacke	X		X	X	X
River Phillip	X	X		X	
Sackville/ Little Sackville			X	X	X
Avon/St. Croix	X	X	X	X	X
Musquodoboit	X		X	X	X
River Hébert	X			X	
Medway		X	X		
Mersey	X		X		
Bear River	X				
St. Mary's	X		X	X	X
Margaree	X	X	X		X
East, West Rivers of Sheet Harbour					X

Note: The "Groundhog Day Storm" of February 2-3, 1976 was reported to have affected only one river basin, i.e. the Annapolis, but wreaked havoc and destruction in all marine areas of the Province. The original estimates of the storm damage exceeded $17.4 million (1986 $s), however, only $7.7 million (1986 $s) were paid out in assistance by the federal and provincial governments.

Photograph 3 — *The former Sackville Downs Property during Flood of August 1971.*

What are the Economic Consequences of Flooding?

Unfortunately, complete and accurate cost statistics are unavailable for most of the Province's flood events. However, if one looks at the damage estimates from just two of the Province's major floods, the magnitude of the problem becomes clear.

Table 2 — Sectoral Damages During Two Selected Flood Events

Events	Public Sector 1986 $s	Private Sector 1986 $s	Total 1986 $s
Jan. 3-8, 1956	$10,114,000	$17,700,000	$27,814,000
Aug. 15-17, 1971	$ 5,006,000	$ 8,421,000	$13,427,000
Totals	$15,120,000	$26,121,000	$41,241,000

Note: The above figures are based on preliminary estimates only which were adjusted to 1986 $s using Building Construction Index, Pg. 60 of Engineering News Record, March 19, 1987.

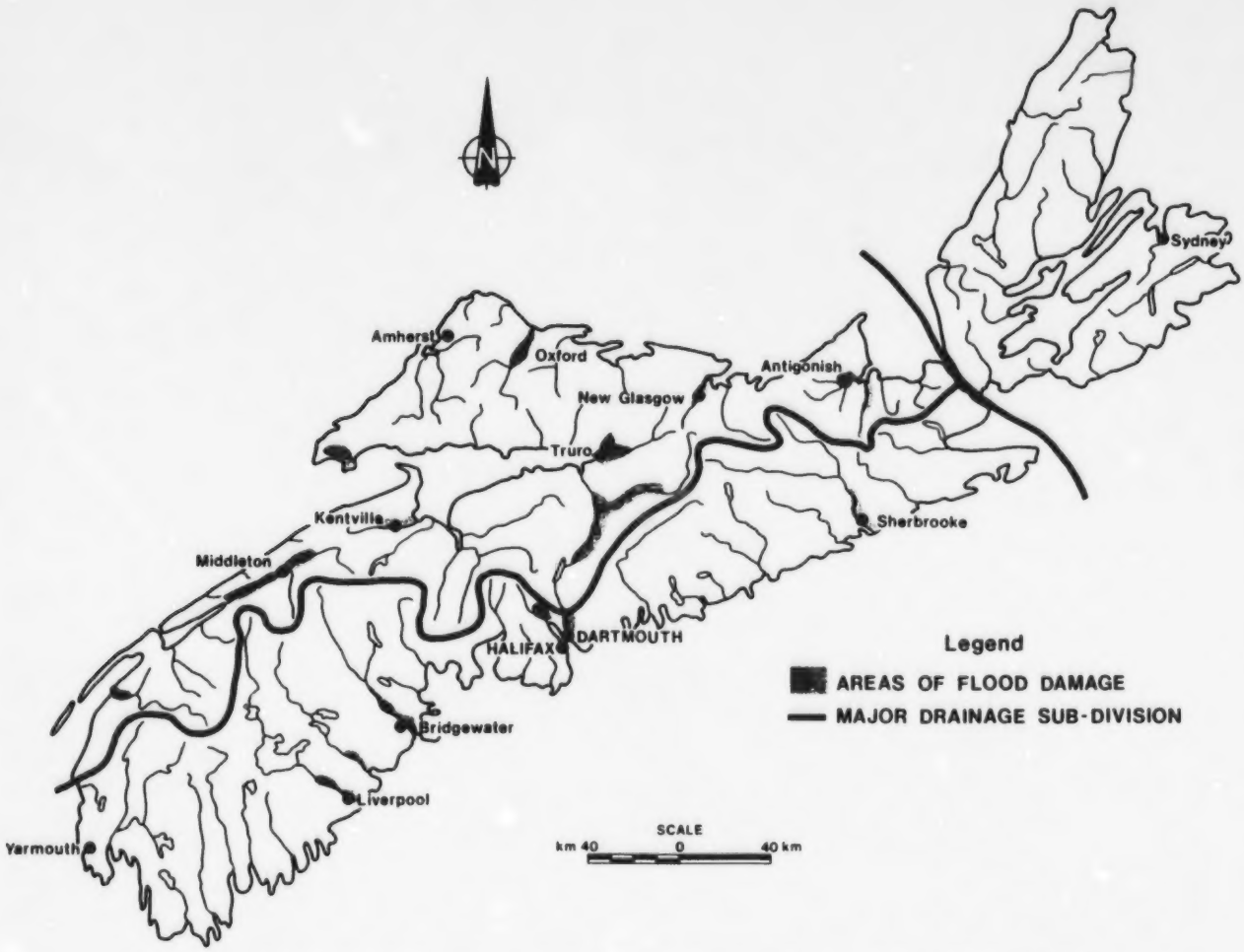


Figure 4: *Nova Scotia River Basins/Communities Most Often Affected During Flood Events.*

Even considering that these events were two of the Province's most destructive floods, one must remember that another 154 floods have been documented since 1759. Floods are costing Canadians, and Nova Scotians in particular, a substantial amount of money.

Railways, highways and utility systems account for most of the public sector damages resulting from floods. During the January, 1956 event, the cost of replacing the over 100 bridges destroyed, no doubt accounted for a high proportion of the $10.1 million (1986 $s) in public sector damages. In the private sector, damages to homes, farms and businesses make up most of the over $26.1 million (1986 $s) cost associated with the above two events. During the August, 1971 flood, the pulp mill in Sheet Harbour alone sustained an estimated $2.6 million (1986 $s) in damages. During this same event, agricultural losses not covered by insurance were estimated at $1.3 million (1986 $s).

Aside from the above direct damages, there are other types of flood-related losses which have a monetary value, but which do not occur as a direct result of flood events. Reductions in property values or crop losses due to late planting are examples of these indirect damages, the impact of which may be felt long after the direct damages of a flood have been repaired. For example, the mill in Upper Stewiacke was forced to close for several days during the September, 1929 flood; the harvesting of hay was delayed during the June, 1959 event; and the entire Fundy Trail Mall in Truro has had to close due to flooding on several occasions, once during the height of the Christmas shopping season in 1975.

There is often a rippling economic effect associated with indirect damages. For instance, when a flood causes a prolonged plant closure or lay-offs, as occurred in Sheet Harbour following the August, 1971 flood, the loss of income leads to reduced retail sales in the affected area. Reduced retail sales cause reduced wholesale orders, affecting a supplier possibly located far from the flood site. As well, all levels of government lose revenue. Indirect damages are generally valued at 50% of the direct loss. This would raise the cost of the August, 1971 flood in Table 2 to $20.1 million (1986 $s).

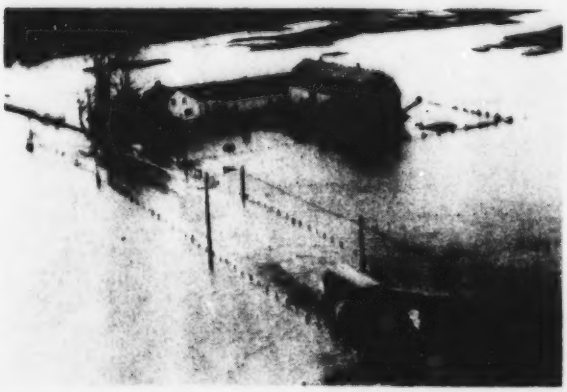
The economic impacts of flooding transcends those people directly and indirectly affected. It affects us all. As taxpayers, we contribute to disaster relief payments made to flood victims and to the repair of public property.

There have also been changes in the use of Nova Scotia's water courses which have reduced some flood-related losses. For example, provincial rivers are no longer used for the transportation of logs and pulpwood, significantly diminishing the direct damages to structures caused by log jams during floods. This has also eliminated the loss of logs and pulpwood, which contributed substantially to the direct damages in many early floods. In addition, the advent of flood risk mapping has provided previously unavailable flood-related intelligence.

Nevertheless, reports of flood damages continue to increase. As seen in Figure 1, there were more reports of damage producing floods in the last three decades than there were in the previous 200 years.

What Are the Human Costs of Flooding?

Most flood-related damages can be assessed in monetary terms, but there is one type of flood-related loss for which such calculations are completely inadequate. To put it bluntly, floods kill. They have taken and continue to take human lives through drowning, train derailments and highway accidents, as seen in Table 3. It should be noted that this table covers only the 30 documented deaths which have occurred since 1759. In all likelihood, there were many other flood-related deaths which did not make this list.



***Photograph 4** — Section of Flooded Highway at Upper Onslow, January 1974.*

In addition to loss of life, there are other intangible costs associated with floods. For instance, it is impossible to put a price on the anguish experienced by people faced with the abandonment of their homes and farms during flood events, such as that which occurred in Middleton in April, 1962, Shubenacadie, Truro and Stellarton in February, 1971, and Eskasoni in February, 1973. School closures and the inconvenience of lengthy detours are also difficult to evaluate in monetary terms.

***Photograph 5** — Receding floodwaters, Brierly Brook Antigonish, August 1971.*

Table 3 — Deaths Attributed to Flooding and/or Flood-Related Accidents in Nova Scotia

Date	Number	Location	Cause of Death
April, 1895	1	Great Village	Drowning
April, 1904	1	Marble Mountain	Drowning
March, 1913	2	Amherst	Drowning
March, 1920	1	Bloody Creek	Drowning
January, 1935	2	Truro and Digby Co.	Drowning
September, 1936	4	Antigonish and Lunenburg Counties	Drowning
September, 1942	2	Eastville	Drowning
July, 1943	2	Brooklyn Corner and Greenwood	Drowning
July, 1946	2	Dartmouth and Arichat	Drowning (1) and car accident (1)
January, 1958	4	Dartmouth, Birchtown, Caledonia and Lunenburg Co.	Drownings (3) and exposure (1)
April, 1962	2	Pleasant Bay and Glenholme	Drowning
May, 1967	1	Middle Stewiacke	Drowning
November, 1969	3	Antigonish	Drowning
March, 1972	1	Bedford	Drowning
January, 1979	1	Wentworth	Storm-related accident
February, 1981	1	Halifax	Drowning

These often tragic human costs should never be overlooked in any assessment of the consequences of flooding.

***Photograph 6** — Flooded section of Avon Street, Bible Hill February 1974.*

Conclusion

It can be clearly seen that floods have been causing damages in Nova Scotia since the mid 18th Century. Increased settlement and development, particularly on or near floodplains have been accompanied by a rise in flood reports over the last 30 years. Individual flood events have been documented to cause in excess of $27 million (1986 $s) in damages.

Convective and cyclonic rainfall, ice jams, snowmelt, surging tidewaters and various combinations of these factors cause the majority of Nova Scotia's flood events, many of which occurred between December and April. Although certain areas of the Province, such as Truro, appear to be more affected by floods than others, significant flood damages have been reported in every region of Nova Scotia.

Flooding continues to be a destructive and costly problem in this Province.

For further information on flooding and flood-related hazards in Nova Scotia, contact:

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